Lenovo Flex System FC5022 16Gb SAN Scalable Switches

Product Guide

The Lenovo Flex System™ FC5022 16Gb SAN Scalable Switch offerings are Gen 5 Fibre Channel (FC) embedded modules for Lenovo Flex System. With up to 48 ports that operate at 16 and 8 Gbps FC speeds, each module provides up to 28 internal ports to compute nodes through the Flex System midplane and up to 20 external SFP+ ports.

The FC5022 SAN switch modules deliver unmatched scalability and flexibility for Flex System users wanting to connect directly into 8 or 16 Gbps FC storage or to an upstream storage area network (SAN). The FC5022 can be configured in the Access Gateway mode using NPIV for simple upstream connectivity or in the Full Fabric more for more advance switching as a part of the larger Fibre Channel fabric.

The switch offers end-to-end 16 Gb with backwards compatibility to 8 Gb and 4 Gb to the SAN connectivity. Monitoring and management are simplified using end-to-end Brocade tools, such as Web Tools and the Brocade Network Advisor (BNA).

Figure 1 shows the switch module.

Figure 1. Lenovo Flex System FC5022 16 Gb SAN Scalable Switch

Did you know?

Only the FC5022 provides up to 48 FC ports in an embedded form factor which provides Flex System a unique differentiation in the market, including the following:

- **Increased I/O density:** Support for 64 Gbps per compute node with only a pair of FC5022 switches can help clients reduce costs on hardware, utility costs and management or operational costs with fewer devices.
- **Greater reliability:** When used with 4-port FC mezzanine adapters, the 28 internal ports enable increased solution availability with greater path redundancy from the ASICs to the modules for no single point of failure.
- **Multi-chassis scalability:** The 20 external SFP+ ports allow for scaling up to 18 chassis without the use of external FC switches, such as FC top-of-rack (ToR) switches, thereby greatly reducing the overall cost of the Flex System solution.

Part number information

The part numbers to order the switch and optional upgrades are shown in Table 1.

Table 1. Part numbers and feature codes for ordering

Description	Part number	Feature code
Switch modules		
Lenovo Flex System FC5022 16Gb SAN Scalable Switch	88Y6374	A1EH
Lenovo Flex System FC5022 24-port 16Gb SAN Scalable Switch (includes two 16 Gb SFPs)	00Y3324	A3DP
Lenovo Flex System FC5022 24-port 16Gb ESB SAN Scalable Switch	90Y9356	A2RQ
Features on Demand upgrades		
Flex System FC5022 16Gb SAN Scalable Switch-Upgrade 1 (12-ports)	88Y6382	A1EP
Flex System FC5022 16Gb SAN Scalable Switch-Upgrade 2 (24-ports)	88Y6386	A1EQ
Flex System FC5022 16Gb ISL/Trunking Upgrade	00Y3322	A3HP

The part numbers for the switches include the following items:

- One Flex System FC5022 16 Gb SAN Scalable Switch (12-port, or 24-port, or 24-port with ESB)
- Two 16 Gb SFP+ optical transceivers (included with 24-port 16 Gb SAN Scalable Switch, part number 00Y3324)
- Important Notices Flyer
- Warranty Flyer
- Documentation CD-ROM

The part numbers for the Features on Demand upgrades include the following items:

- Features on Demand Activation Flyer
- Upgrade authorization letter

The switch does not include a serial management cable, however, Flex System Management Serial Access Cable, part number 90Y9338, is supported and contains two cables, a mini-USB-to-RJ45 serial cable and a mini-USB-to-DB9 serial cable, either of which can be used to connect to the switch locally for configuration tasks and firmware updates.

The FC5022 12-port and 24-port ESB SAN switches come without SFP+ media, which must be ordered separately to provide outside connectivity. The FC5022 24-port SAN switch (part number 00Y3324) comes standard with two Brocade 16 Gb SFP+ transceivers. Additional SFP+ can be ordered, if required. Table 2 lists the supported SFP+ options.

Table 2. Supported SFP+ transceivers

Description	Part number	Feature code	Max qty supported
16 Gb FC SFP+ transceivers			
Brocade 16 Gb SW SFP+ Optical Transceiver	88Y6393	A22R	20
Brocade 16GB 10KM LW SFP+ Transceiver	00MY768	ASK2	20
Brocade 16GB 25KM ELW SFP+ Transceiver	00MY770	ASK3	20*
8 Gb FC SFP+ transceivers			
Brocade 8Gb SW SFP+ Optical Transceiver	88Y6416	5084	20

Description	Part number	Feature code	Max qty supported
Brocade 8GB 10KM LW SFP+ Transceiver	00MY764	ASK0	20
Brocade 8GB 25KM ELW SFP+ Transceiver	00MY766	ASK1	20*
Optical cables for 8 Gb and 16 Gb FC SW SFP+ transceivers			
Lenovo 0.5m LC-LC OM3 MMF Cable	00MN498	ASR5	20
Lenovo 1m LC-LC OM3 MMF Cable	00MN502	ASR6	20
Lenovo 3m LC-LC OM3 MMF Cable	00MN505	ASR7	20
Lenovo 5m LC-LC OM3 MMF Cable	00MN508	ASR8	20
Lenovo 10m LC-LC OM3 MMF Cable	00MN511	ASR9	20
Lenovo 15m LC-LC OM3 MMF Cable	00MN514	ASRA	20
Lenovo 25m LC-LC OM3 MMF Cable	00MN517	ASRB	20
Lenovo 30m LC-LC OM3 MMF Cable	00MN520	ASRC	20

* When using ELW SFPs over distances over 10 km, the Extended Fabric feature is required on a SAN switch to drive the maximum bandwidth over the extended links. The Extended Fabric feature is included in the FC5022 ESB switch module (part number 90Y9356). The ELW SFPs are not available for selection for the non-ESB FC5022 switch modules (part numbers 88Y6374 and 00Y3324).

Table 3 provides a feature comparison by model for Flex System FC5022 switches.

Table 3. Feature comparison by model

Feature	24-port 16 Gb ESB SAN switch	24-port 16 Gb SAN switch	16 Gb SAN switch
Number of licensed ports	24	24	12
Number of SFP+ included	0	2 x 16 Gb SFP+	0
Full fabric	Included	Included	Included
Access Gateway	Included	Included	Included
Advanced zoning	Included	Included	Included
Enhanced Group Management	Included	Included	Included
Adaptive Networking	Included	Included	Included
ISL Trunking	Included	Optional	Optional
Fabric Vision*	Included	Not available	Not available
Advanced Performance Monitoring	Included	Not available	Not available
Fabric Watch	Included	Not available	Not available
Extended Fabrics	Included	Not available	Not available
Server Application Optimization	Included	Not available	Not available

* With Fabric OS 7.2 and above, the Brocade Fabric Vision functionality is included with the 24-port 16 GB ESB SAN switch, but may not be displayed as an individual license key. The functionality may instead be displayed along with the Fabric Watch and Advanced Performance Monitoring license descriptions with the added verbiage "Fabric Vision Capable."

Table 4 provides compatibility information for the switch modules and Features on Demand upgrades for them.

Table 4. Features on Demand upgrade compatibility

Features on Demand upgrade	Part number	24-port 16 Gb ESB SAN switch	24-port 16 Gb SAN switch	16 Gb SAN switch
Flex System FC5022 16Gb SAN Scalable Switch-Upgrade 1 (12-ports)	88Y6382	No	No	Yes
Flex System FC5022 16Gb SAN Scalable Switch-Upgrade 2 (24-ports)	88Y6386	Yes	Yes	Yes
Flex System FC5022 16Gb ISL/Trunking Upgrade	00Y3322	No*	Yes	Yes

* This feature is already included in the bundle.

With Brocade's Dynamic Ports on Demand (DPOD) feature, ports are licensed in one of two methods: as they come online or as selected by the administrator. With the 16 Gb SAN switch, the first 12 ports reporting (on a first-come, first-served basis) on boot-up are assigned licenses. These 12 ports can be any combination of external or internal Fibre Channel (FC) ports. After all port licenses have been assigned, you can manually move those licenses from one port to another. Because this is dynamic, no defined ports are reserved except ports 0 and 29. The 24-port 16 Gb SAN switches have the same behavior; the only difference is the number of ports, which is 24.

Table 5 shows the total number of port licenses on the switch after applying compatible port upgrades.

Note: A maximum of one upgrade of each type (one Upgrade 1 and one Upgrade 2) is supported per one switch module. Upgrade 1 and Upgrade 2 can be applied independently of each other.

Table 5. Ports on Demand upgrades

Ports on Demand upgrade	Total number of port licenses		
	24-port 16 Gb ESB SAN switch	24-port 16 Gb SAN switch	12-port 16 Gb SAN switch
Included with base	24	24	12
Upgrade 1, 88Y6382 only (adds 12 port licenses)	Not supported	Not supported	24
Upgrade 2, 88Y6386 only (adds 24 port licenses)	48*	48*	36
Both Upgrade 1, 88Y6382 and Upgrade 2, 88Y6386 (add 36 port licenses)	Not supported	Not supported	48*

* With the dual-port FC adapters installed in compute nodes, up to 34 ports (14 internal, 20 external) can be utilized. The remaining 14 internal ports require use of the 4-port FC adapters in the server's ITE.

Benefits

The switches offer the following key benefits:

- Exceptional price/performance for growing SAN workloads
  The FC5022 16 Gbps switch delivers exceptional price/performance for growing SAN workloads through a combination of market-leading 1600 MB/sec throughput per port and an affordable high-density, 12-port to 48-port form factor.
- Enhanced server performance while using 16 Gb Gen 5 FC technology
  Using 16 Gb FC adapters on the server and the FC5022 modules can help achieve the following server enhancements, even if 8 Gb FC storage is used:
  - Up to 30-50% better virtual machine density and higher number of concurrent users due to increased storage bandwidth

- Up to 20-40% fewer servers required to support the workload specified
- Twice lower number and higher speed of inter-switch links required in scalable SANs
- Higher reliability and availability of services due to fewer number of components used to build the solution
- Twice faster access to the business critical data
- Lower acquisition costs due to fewer number of systems and components
- Shorten ROI time frame and decrease overall TCO with the efficient utilization of server resources and lower power, cooling, and management costs

See Lenovo Press paper "Positioning Flex System 16 Gb Fibre Channel Fabric for Storage-Intensive Enterprise Workloads" for details:
http://lenovopress.com/redp4921

- Superior scalability for internal and external ports that reduces costs and increases availability
  The FC5022 16 Gb switch is the only switch that provides up to 28 internal server facing FC ports, which allows the Flex System chassis to scale to 28 compute nodes in a single chassis (when using double density half-width compute nodes) that lowers the overall per-server cost of the solution. These 28 internal ports also enable greater path redundancy for ITEs using the 4-port FC mezzanine adapters. Additionally, the FC5022 offers an industry leading 20 external SFP+ ports that allows for multi-chassis scalability up to 18 chassis without the use of external FC switches, thereby greatly reducing the overall cost of the Flex Solution.
- Accelerating fabric deployment and serviceability with Brocade ClearLink and Fabric Vision
  Brocade ClearLink is a feature supported by the FC5022 16 Gb Switch that enables administrators to quickly identify and isolate 16 Gbps optic, port, and cable problems, reducing fabric deployment and diagnostic times. Brocade Fabric Vision Technology offers innovative diagnostic, monitoring, and management capabilities to help administrators avoid problems, maximize application performance, and reduce operational costs.
- A building block for virtualized, private cloud storage
  The FC5022 16 Gb Switch supports multi-tenancy in cloud environments through VM-aware end-to-end visibility and monitoring, Quality of Service (QoS), and fabric-based advanced zoning features. The FC5022 enables secure long distance extensions to virtual private or hybrid clouds with dark fiber support, as well as in-flight encryption and data compression.
- Seamless integration with the existing Brocade fabric in Full Fabric mode
  The FC5022 switch in Full Fabric mode provides native support for the advanced fabric features of the Brocade SAN fabric.
- Simplified interconnect to existing SAN environments with Brocade Access gateway (NPIV) operational mode
  All models of the FC5022 16 Gb Switch can be deployed as an Access Gateway, which simplifies fabric topologies and heterogeneous fabric connectivity. Access Gateway mode utilizes N_Port ID Virtualization (NPIV) switch standards to present physical and virtual servers directly to the core of SAN fabrics. This makes it transparent to the SAN fabric, greatly reducing management of the network edge. The FC5022 Scalable Switch in Access Gateway mode can connect servers to NPIV-enabled SAN fabrics, including Brocade or Cisco SAN fabrics.
- Maximizing investments
  To help optimize technology investments, Lenovo offers a single point of serviceability backed by industry-renowned education, support, and training. In addition, the Lenovo 16/8 Gbps SAN Scalable Switch is in the ServerProven® program, ensuring compatibility among a variety of Lenovo and partner products.

Features and specifications

The FC5022 16 Gb Switches have the following features and specifications:

- Internal ports
  - 28 internal full-duplex 16/8 Gb FC ports
  - Internal ports operate as F_ports (fabric ports) in native mode or in access gateway mode
  - Two internal full-duplex 1 GbE ports connected to the chassis management module
  - Support for the 2-port and 4-port FC adapter cards
- External ports
  - 20 external ports for 16 Gb or 8 Gb SFP+ transceivers supporting 4 Gb, 8 Gb, and 16 Gb port speeds (supported SFP+ modules are listed in Table 2). Ports are auto-sensing and activated with the Dynamic Ports on Demand feature.
  - External ports can operate as F_ports (fabric ports) or E_ports (expansion ports) in native mode or as N_ports NPIV (node ports) in Access Gateway mode
  - One external 1 GbE port (1000BASE-T) with RJ-45 connector for switch configuration and management (IPv4 and IPv6 support)
  - One RS-232 serial port (mini-USB connector) that provides an additional means to configure the switch module
- Access Gateway mode (N_Port ID Virtualization - NPIV) support
- Mirror Port (M-Port) allows you to mirror traffic to an external port between a specific host and target
- Power-on self-test diagnostics and status reporting
- Inter-Switch Link (ISL) Trunking (licensable or included with the 24-port ESB model), which allows up to eight ports (at 16, 8, or 4 Gbps speeds) to combine to form a single, logical ISL with a speed of up to 128 Gbps (256 Gbps full duplex) for optimal bandwidth utilization, automatic path failover, and load balancing
- Fabric OS (FOS) version 7.0.x or higher, which delivers distributed intelligence throughout the network and enables a wide range of value-added applications, such as Advanced Web Tools and Advanced Fabric Services (on certain models)
- Supports up to 768 Gbps end-to-end full-duplex aggregated bandwidth
- 420 million frames switch per second, 0.7 microseconds latency
- 8192 buffers for up to 3750 km extended distance at 4 Gbps FC (Extended Fabrics license required)
- In-flight 64 Gbps FC compression and decompression support on up to two external ports (no license required)
- In-flight 32 Gbps encryption and decryption on up to two external ports (no license required)
- 48 Virtual Channels (VCs) per port
- Fabric scalability of up to 239 switches in Full Fabric mode
- Port mirroring to monitor ingress or egress traffic from any port within the switch
- Two I2C connections able to interface to redundant management modules
- Hot pluggable switches in the chassis and SFP+ optical transceivers in the switches
- Single fuse circuit
- Four temperature sensors
- One internal real-time clock
- Managed with Web Tools
- Supports up to 128 domains in Native mode and Interoperability mode
- Full fabric switch mode may be changed to or from Access Gateway mode
- Nondisruptive code load in Native mode and Access Gateway (NPIV) mode
- 255 NPIV N_port logins per physical port

- D_port support on external ports (16Gbps SFP+ only)
- Class 2 and Class 3 frames Class of Service
- Registered State Change Notification (RSCN)
- FTP support for firmware upgrades
- SNMP/MIB monitoring functionality contained within the Ethernet Control MIB-II (RFC1213-MIB)
- UUID put into MIB structure
- End-to-end optics and link validation
- Ability to send switch events and syslogs to the Chassis Management Module (CMM)
- Traps identify cold start, warm start, link up/link down, and authentication failure events
- Support for IPv4 and IPv6 on the management ports
- Advanced SAN Fabric Services
    - Bottleneck Detection
    - Dynamic Fabric Provisioning (DFP)
    - Dynamic Path Selection (DPS)
    - Enhanced BB credit recovery
    - FDMI
    - Frame Redirection
    - Frame-based Trunking
    - FSPF
    - IPoFC
    - Management Server
    - NPIV
    - NTP v3
    - Port Fencing
    - Reliable Commit Service (RCS)
    - Simple Name Server (SNS)
- Software management
    - HTTPS
    - SNMP v1/v3 (FE MIB, FC Management MIB)
    - SSH
    - Auditing
    - Syslog
    - APM
    - Network Advisor (base edition standard, ProPlus or Enterprise optional license)
    - Command Line Interface (CLI)
    - SMI-S compliant
    - Administrative Domains
- Security management
    - AES-GCM-256 encryption on ISLs
    - DH-CHAP (between switches and end devices)
    - FCAP switch authentication
    - FIPS 140-2 L2-compliant
    - HTTPS
    - IPsec
    - IP filtering
    - LDAP with IPv6
    - Port Binding
    - RADIUS
    - User-defined Role-Based Access Control (RBAC)
    - Secure Copy (SCP)
    - Secure RPC
    - SFTP

    - SSH v2
    - SSL
    - Switch Binding
    - Trusted Switch
- Diagnostics
    - D_Port offline diagnostics (16 Gbps optics only)
        - Electrical/optical loopback
        - Link traffic/latency/distance
    - POST and embedded online/offline diagnostics
        - Environmental monitoring
        - FCping
        - Pathinfo (FC traceroute)
        - Frame viewer
        - Non-disruptive daemon restart
        - Port mirroring
        - Optics health monitoring
        - Power monitoring
        - RAS trace logging
        - Rolling Reboot Detection (RRD)

Flex System FC5022 switches come standard with the following software features:

- Full Fabric mode: Enables high performance 16 Gb or 8 Gb fabric switching
- Access Gateway mode: Leverages NPIV to connect to any fabric without adding switch domains to reduce management complexity
- Dynamic Path Selection: Enables exchange-based load balancing across multiple Inter-Switch Links for superior performance
- Advanced Zoning: Segments a SAN into virtual private SANs to increase security and availability
- Enhanced Group Management: Enables centralized and simplified management of SAN fabrics through Brocade Network Advisor
- Server Application Optimization: Allows VM QoS, authentication, and monitoring from SAN through adapter to VM and associated virtualized application

The 24-port ESB model (part number 90Y9356) is a fully enabled switch with a complete set of licensed features that maximizes performance, ensures availability, and simplifies management for the most demanding applications and expanding virtualization environments. The factory-installed licenses include:

- ISL Trunking: Consolidates ISLs into fault-tolerant and load-balanced trunks with bandwidth of up to 128 Gbps for greater performance and simplified management
- Adaptive Networking: Ensures high-priority connections that obtain the bandwidth necessary for optimum performance
- Advanced Performance Monitoring: Provides end-to-end visibility into fabric performance to maximize performance tuning and the utilization of fabric resources
- Fabric Watch: Monitors and creates alerts based on the health of switch and fabric elements
- Extended Fabrics: Extends Fibre Channel SANs beyond traditional distance limitations for replication and backup at full bandwidth

Supported Fibre Channel standards

The switch supports the following FC standards:

- FC-AL-2 INCITS 332: 1999
- FC-GS-5 ANSI INCITS 427 (includes the following):
    - FC-GS-4 ANSI INCITS 387: 2004
- FC-IFR INCITS 1745-D, revision 1.03 (under development)
- FC-SW-4 INCITS 418:2006 (includes the following):
    - FC-SW-3 INCITS 384: 2004
- FC-VI INCITS 357: 2002
- FC-TAPE INCITS TR-24: 1999
- FC-DA INCITS TR-36: 2004 (includes the following):
    - FC-FLA INCITS TR-20: 1998
    - FC-PLDA INCIT S TR-19: 1998
- FC-MI-2 ANSI/INCITS TR-39-2005
- FC-PI INCITS 352: 2002
- FC-PI-2 INCITS 404: 2005
- FC-PI-4 INCITS 1647-D, revision 7.1 (under development)
- FC-PI-5 INCITS 479: 2011
- FC-FS-2 ANSI/INCITS 424:2006 (includes the following):
    - FC-FS INCITS 373: 2003
- FC-LS INCITS 433: 2007
- FC-BB-3 INCITS 414: 2006 (includes the following):
- FC-BB-2 INCITS 372: 2003
- FC-SB-3 INCITS 374: 2003 (replaces FC-SB ANSI X3.271: 1996; FC-SB-2 INCITS 374: 2001)
- RFC 2625 IP and ARP Over FC
- RFC 2837 Fabric Element MIB
- MIB-FA INCITS TR-32: 2003
- FCP-2 INCITS 350: 2003 (replaces FCP ANSI X3.269: 1996)
- SNIA Storage Management Initiative Specification (SMI-S) Version 1.2 (includes the following):
    - SNIA Storage Management Initiative Specification (SMI-S) Version 1.03 ISO standard IS24775-2006. Replaces (ANSI INCITS 388: 2004)
    - SNIA Storage Management Initiative Specification (SMI-S) Version 1.1.0
    - SNIA Storage Management Initiative Specification (SMI-S) Version 1.2.0

Supported chassis and adapter cards

The switches are installed in switch bays in the rear of the Flex System chassis, as shown in Figure 2. Switches are normally installed in pairs since ports on the I/O adapter cards installed in the compute nodes are routed to two switch bays for redundancy and performance.

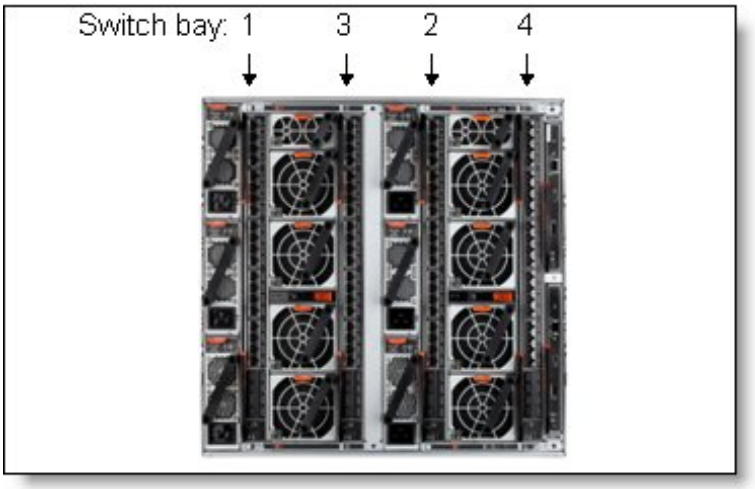

Figure 2. Location of the switch bays in the Flex System chassis

Table 6 shows compatibility information for the FC5022 and Flex System chassis.

Table 6. Flex System chassis compatibility

Description	Part number	Enterprise Chassis with CMM	Enterprise Chassis with CMM2	Carrier-grade Chassis with CMM2
Lenovo Flex System FC5022 16Gb SAN Scalable Switch	88Y6374	Yes	Yes	Yes
Lenovo Flex System FC5022 24-port 16Gb SAN Scalable Switch	00Y3324	Yes	Yes	Yes
Lenovo Flex System FC5022 24-port 16Gb ESB SAN Scalable Switch	90Y9356	Yes	Yes	Yes

The connections between the 2-port adapters that are installed in the compute nodes and the switch bays in the chassis are shown in Figure 3. Figure 3 shows both half-wide servers, such as the x240 with two adapters, and full-wide servers, such as the x440 with four adapters.

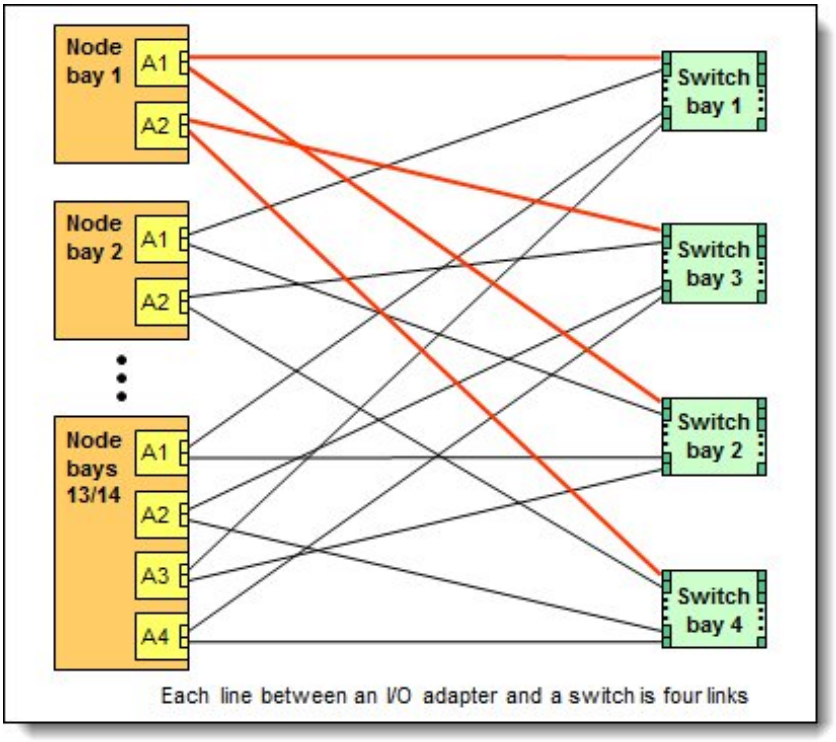

Figure 3. Logical layout of the interconnects between the 2-port FC adapters and I/O modules

The connections between the 4-port FC adapters that are installed in the compute nodes and the switch bays in the chassis are shown in Figure 4.

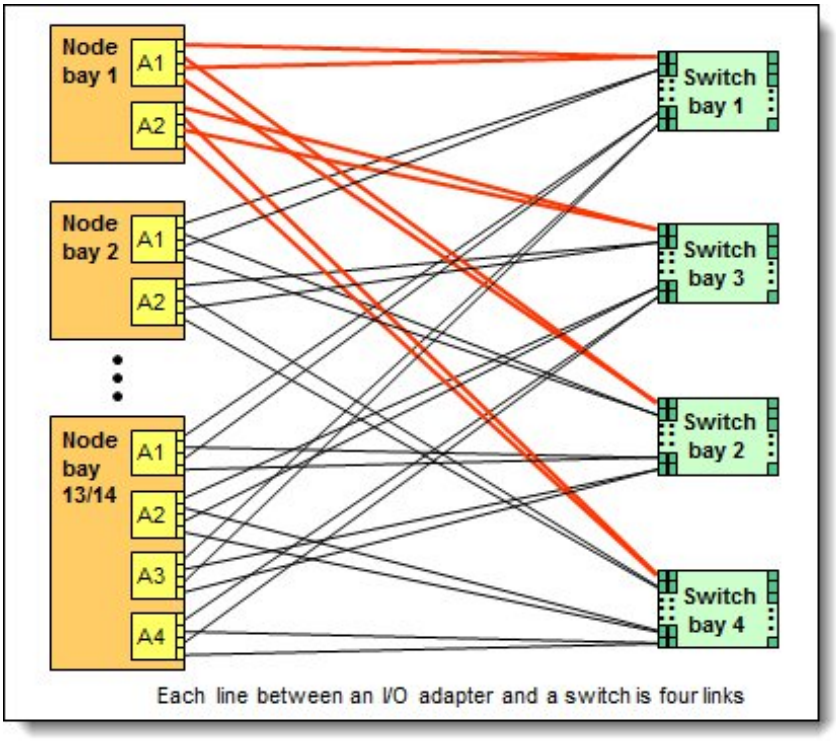

Figure 4. Logical layout of the interconnects between the FC5054 4-port adapters and I/O modules

The Flex System FC5022 16Gb SAN Scalable Switches can be installed in bays 1, 2, 3, and 4 of the Flex System chassis. A supported adapter card must be installed in a corresponding slot of the compute node (slot A1 when switches are installed in bays 1 and 2 or slot A2 when switches are in bays 3 and 4).

With compute nodes that have an integrated dual-port 10 GbE network interface controller (NIC) these switches can only be installed in bays 3 and 4 because integrated NICs ports are routed to bays 1 and 2 with a specialized periscope connector and the FC adapter card cannot be installed in slot A1. When needed, however, the periscope connector can be replaced with an FC adapter card, in which case the integrated NIC will be disabled and FC switches can be used in bays 1 and 2.

Table 7 shows the connections between dual-port and 4-port FC adapters installed in the compute nodes other than x222 to the switch bays in the chassis with Flex System FC5022 16 Gb SAN Scalable Switches.

Table 7. Adapter to I/O bay correspondence

I/O adapter slot in the server	Port on the adapter	Corresponding I/O module bay in the chassis
Slot 1	Port 1	Module bay 1
	Port 2	Module bay 2
	Port 3	Module bay 1
	Port 4	Module bay 2
Slot 2	Port 1	Module bay 3
	Port 2	Module bay 4
	Port 3	Module bay 3
	Port 4	Module bay 4
Slot 3 (full-wide compute nodes only)	Port 1	Module bay 1
	Port 2	Module bay 2
	Port 3	Module bay 1
	Port 4	Module bay 2
Slot 4 (full-wide compute nodes only)	Port 1	Module bay 3
	Port 2	Module bay 4
	Port 3	Module bay 3
	Port 4	Module bay 4

Table 8 shows the connections between 4-port adapters installed in the x222 compute nodes to the switch bays in the chassis with Flex System FC5022 16Gb SAN Scalable Switches.

Table 8. x222 adapter to I/O bay correspondence

Server	FC5024D 4-port 16Gb FC Adapter	Corresponding I/O module bay in the chassis
Upper server	Port 1	Module bay 3
	Port 2	Module bay 4
Lower server	Port 1	Module bay 3
	Port 2	Module bay 4

With the x222, each node bay consumes four ports on the switch, therefore, additional port licenses might be needed depending on your configuration (see Table 1 for FoD port upgrades).

Table 9 lists the storage I/O adapters supported by the FC5022 16Gb SAN Scalable Switches. With 8 Gb FC adapters, internal ports on a switch operate at 8 Gb speeds.

Table 9. Storage adapters

Description	Part number	Feature code
16 Gb Fibre Channel		
Flex System FC5022 2-port 16Gb FC Adapter	88Y6370	A1BP
Flex System FC5024D 4-port 16Gb FC Adapter	95Y2379	A3HU
Flex System FC5052 2-port 16Gb FC Adapter	95Y2386	EC23
Flex System FC5054 4-port 16Gb FC Adapter	95Y2391	EC2E
Flex System FC5172 2-port 16Gb FC Adapter	69Y1942	A1BQ
8 Gb Fibre Channel		
Flex System FC3172 2-port 8Gb FC Adapter	69Y1938	A1BM
Flex System FC3052 2-port 8Gb FC Adapter	95Y2375	A2N5

The adapters are installed in slots in each compute node. Figure 5 shows the locations of the slots in the x240 Compute Node. The positions of the adapters in the other supported servers are similar.

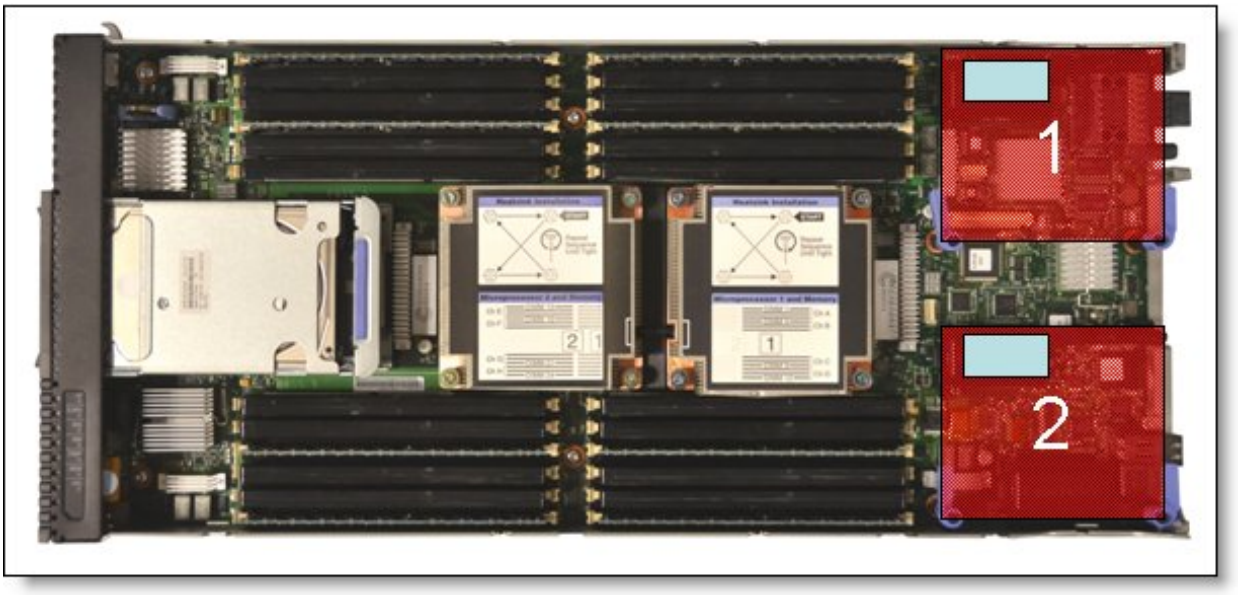

Figure 5. Location of the I/O adapter slots in the Flex System x240 Compute Node

Connectors and LEDs

Figure 6 shows the front panel of the Lenovo Flex System FC5022 16Gb SAN Scalable Switches.

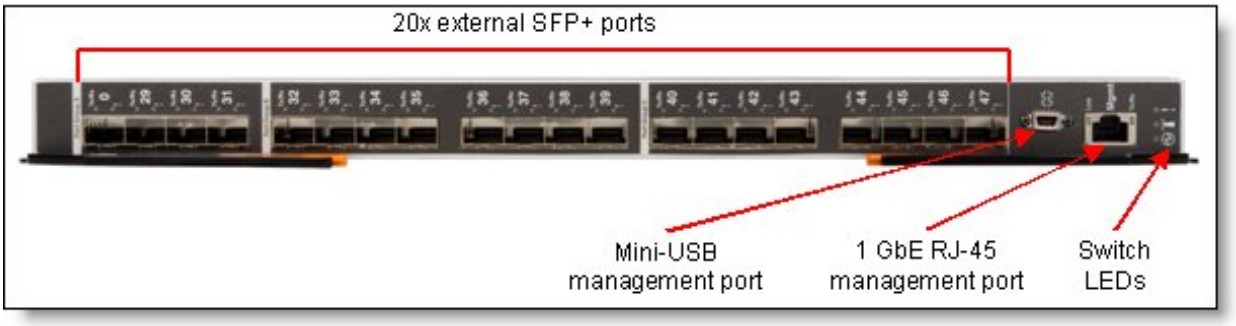

Figure 6. Front panel of the Lenovo Flex System FC5022 16Gb SAN Scalable Switches

The front panel contains the following components:

- LEDs that display the status of the switch module and the fabric:
  - The OK LED indicates that the switch module has passed the power-on self-test (POST) with no critical faults and is operational.
  - The blue Identify LED can be used to identify the switch physically, by illuminating via the management software.
  - The Error LED (switch module error) indicates that the switch module has failed the POST or detected an operational fault.
- One mini-USB RS-232 console port that provides an additional means to configure the switch module. This mini-USB-style connector enables connection of a special serial cable (cable is optional and it is not included with the switch; see the part number information section for details).
- One 1 Gb Ethernet RJ-45 port for switch configuration and management
- 20 external SFP+ port connectors to attach SFP+ modules for 16 Gb, 8 Gb or 4 Gb connections to external FC devices
- An FC link error LED and an FC Tx/Rx LED for each external port on the switch

Cabling requirements

Table 10 lists the cables required for the switch.

Table 10. FC5022 cabling requirements

Transceiver	Cable	Connector
16 Gb Fibre Channel		
16 Gb FC SW SFP+ Module	Up to 30 m with fiber optic cables supplied by Lenovo (see Table 2); 850 nm OM3 multimode fiber up to 100 m or OM4 multimode fiber up to 125 m	LC
16 Gb FC LW SFP+ Module	1310 nm single-mode fiber cable (9 µ) up to 10 km	LC
16 Gb FC ELW SFP+ Module	1310 nm single-mode fiber cable (9 µ) up to 25 km	LC
8 Gb Fibre Channel		
8 Gb FC SW SFP+ Module	Up to 30 m with fiber optic cables supplied by Lenovo (see Table 2); 850 nm OM3 multimode fiber up to 150 m	LC
8 Gb FC LW SFP+ Module	1310 nm single-mode fiber cable (9 µ) up to 10 km	LC
8 Gb FC ELW SFP+ Module	1310 nm single-mode fiber cable (9 µ) up to 25 km	LC
Management ports		
External 1 GbE management port	UTP Category 5, 5E, and 6 up to 100 meters	RJ-45
External RS-232 management port	DB-9-to-mini-USB or RJ-45-to-mini-USB console cable (comes with optional Management Serial Access Cable, 90Y9338)	Mini-USB

Warranty

The FC5022 switches carry a 1-year, customer-replaceable unit (CRU) limited warranty. When installed in a chassis, these switches assume your system's base warranty and any Lenovo warranty service upgrade.

Physical specifications

The approximate dimensions and weight of the switch are as follows:

- Height: 30 mm (1.2 in.)
- Width: 401 mm (15.8 in.)
- Depth: 317 mm (12.5 in.)
- Weight: 3.2 kg (7.1 lb)

The shipping dimensions and weight (approximate) of the switch are as follows:

- Height: 114 mm (4.5 in.)
- Width: 508 mm (20.0 in.)
- Depth: 432 mm (17.0 in.)
- Weight: 3.6 kg (8.1 lb)

Operating environment

The FC5022 swithces are supported in the following environment:

- Temperature
  - Operating: 0°C to 35°C (32°F to 95°F)
  - Non-operating: 5°C to 45°C (41°F to 113°F)
- Altitude
  - Up to 3,000 m (10,000 ft) above sea level
- Humidity
  - Operating: 20% to 80%, noncondensing at 29°C
  - Non-operating: 8% to 80%, noncondensing at 38°C

Regulatory compliance

The switch conforms to the following standards:

- US: UL, CB, TUV reports and certificates per EN60950-1 2001 / IEC60950-1 2001
- Canada: CSA C22.2 No. 950 or 60950
- Germany: TUV/VDE IEC 950/EN 60950 (TUV component report & IEC60950 CB Report and Certificate)
- FCC - Title 47 CFR Part 15, Class A
- Canada - ICES-003
- Australia/New Zealand - C-Tick - AS/NZS CISPR 22:2006
- CE Mark - EN55022:2006+A1:2007 and EN55024:1998+A1:2001+A2:2003
- VCCI Class A - Japan VCCI 2009
- Korea's EMC with KCC marking (previously MIC marking)
- MIC Notice No. 1996-78 (Korea)
- CISPR 22 Class A
- Taiwan BSMI – CNS 13438
- Turkey Communiqué No. 2004/9 and No. 2004/22
- Saudi Arabia – EMC.CVG, 28 October 2002
- China – GB 9524:1998

Typical configurations

The Flex System compute nodes with the mezzanine FC HBAs installed are connected to the FC5022 switch modules through the chassis midplane. The FC5022 switches are connected to an external SAN or to a storage system directly. The following connectivity scenarios are described:

- Attachment to a SAN in transparent mode (also known as Pass-thru or Access Gateway mode)
- Attachment to a Brocade SAN in Full Fabric mode
- Direct attachment to an external storage system

Attachment to a SAN in transparent mode

In the scenario shown in Figure 7, the FC5022 switch module is configured in the Access Gateway mode and connected to an upstream SAN fabric to access the storage. This upstream fabric can be either Brocade SAN or Cisco MDS fabric.

The FC5022 in the Access Gateway mode acts as a transparent traffic forwarder where all traffic from the HBAs in the Flex System compute nodes are sent to the upstream SAN fabric for processing. This reduces the number of physical switches in the SAN fabric and simplifies management. This configuration can be used in small, medium, and large SAN environments.

In this scenario, the FC5022 external connection to the upstream SAN fabric is displayed as an N-Port. SAN fabric configuration, such as zoning, is performed on the upstream SAN switch instead of the FC5022. For more information, refer to the *Brocade Fabric OS Access Gateway Administrator's Guide*.

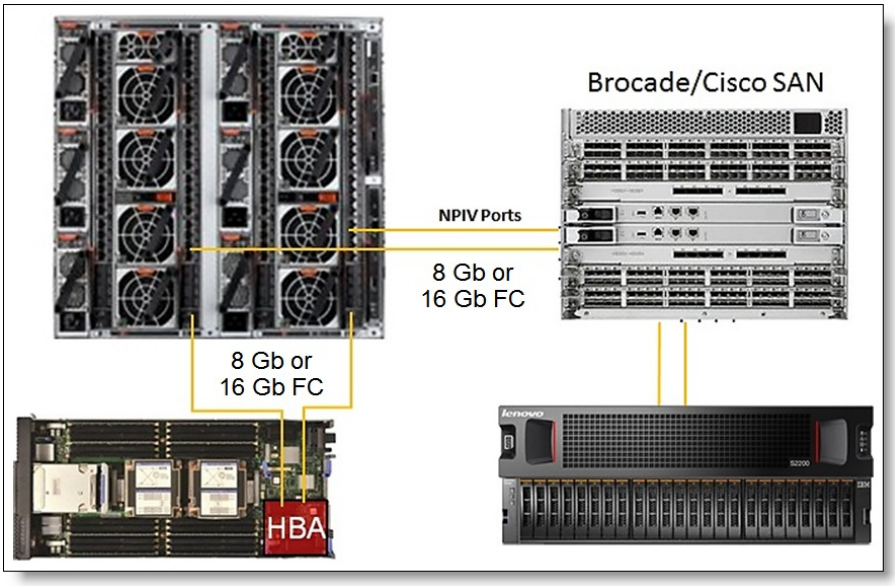

Figure 7. Access Gateway mode

Attachment to a Brocade SAN in Full Fabric mode

In this scenario shown in Figure 8, the FC5022 has an external connection to the Brocade FC SAN. SAN fabric configuration for the newly added Flex System hosts is performed on the upstream Brocade SAN. When the FC5022 is attached to the upstream Brocade SAN fabric, the zoning information and high level configuration parameters are automatically propagated down to the FC5022, allowing the newly attached hosts to communicate with their targets that were defined on the upstream SAN.

For more information on how to configure and manage the FC5022 switch module, refer to the *Brocade Fabric OS Administrator's Guide* and *Brocade Fabric OS Command Reference Manual*.

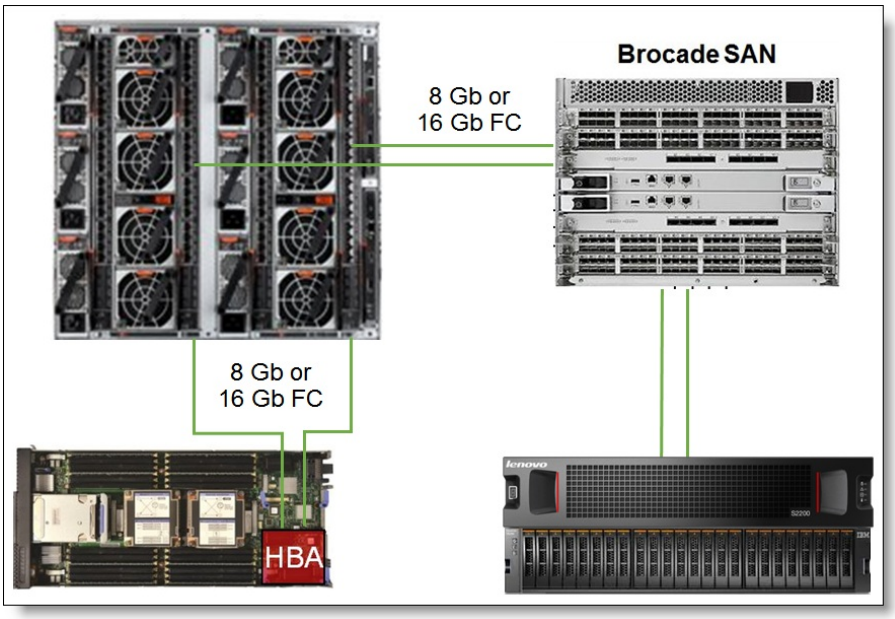

Figure 8. Full Fabric mode

Direct attachment to an external storage system

In this scenario shown in Figure 9, the FC5022 has an external direct connection to the FC storage. SAN fabric configuration, including zoning, is performed on the FC5022.

For more information on how to configure and manage the FC5022 switch module, refer to the *Brocade Fabric OS Administrator's Guide* and the *Brocade Fabric OS Command Reference Manual*.

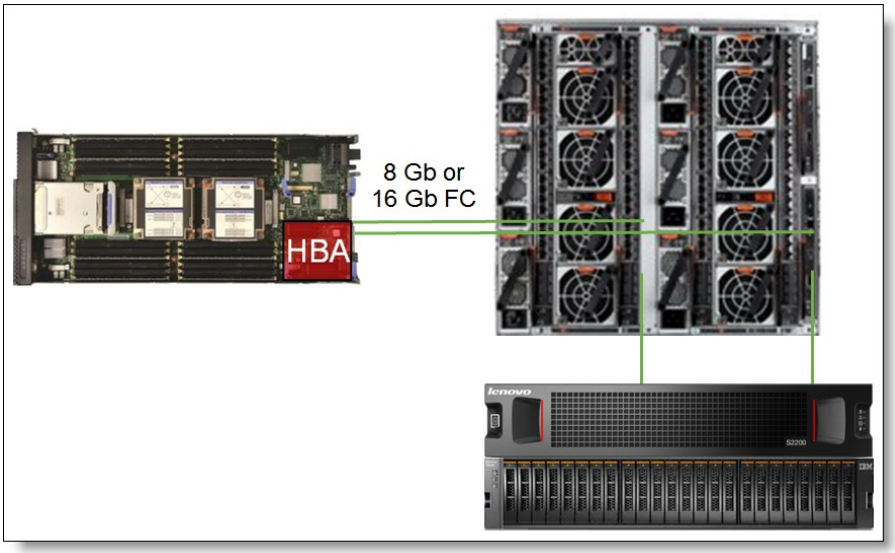

Figure 9. Direct-attached storage

Related publications and links

For more information see the Lenovo Flex System FC5022 16Gb SAN Switches product publications, available from the Flex System Information Center:
http://publib.boulder.ibm.com/infocenter/flexsys/information/index.jsp

- *User's Guide*

The following Fabric Operating System publications are available (visit the Information Center for the FC5022 and click the following link:
http://ibm.brocadeassist.com/public/FabricOSv7xRelease)

- *Fabric OS Administrator's Guide*
- *Network Advisor SAN User Manual*
- *Access Gateway Administrator's Guide*
- *Fabric OS Command Reference Manual*
- *Fabric OS MIB Reference Manual*
- *Fabric OS System Error Message Reference Manual*
- *Web Tools Administrator's Guide*
- *Secure Fabric OS Administrator's Guide*
- *Fabric Watch Administrator's Guide*

Other documents:

- US Announcement Letter for the 16Gb SAN and 24-port ESB SAN switches
  http://ibm.com/common/ssi/cgi-bin/ssialias?infotype=dd&subtype=ca&&htmlfid=897/ENUS112-053
- US Announcement Letter for the 16Gb 24-port SAN switch
  http://ibm.com/common/ssi/cgi-bin/ssialias?infotype=dd&subtype=ca&&htmlfid=897/ENUS112-139
- US Announcement Letter for the Features on Demand upgrades
  http://ibm.com/common/ssi/cgi-bin/ssialias?infotype=dd&subtype=ca&&htmlfid=897/ENUS112-185
- Flex System Enterprise Chassis Product Guide
  http://lenovopress.com/tips0865
- The Benefits of 16 Gb Fibre Channel in Flex System Solutions
  http://lenovopress.com/redp4921
- Flex System FC5022 2-port 16Gb FC Adapter
  http://lenovopress.com/tips0891
- Lenovo Flex System Products and Technology, SG24-8255
  http://lenovopress.com/sg248255
- Flex System Interoperability Guide
  http://lenovopress.com/fsig

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